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SOUTHERN FOREST EXPERIMENT STATION, FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE

Moon Dust Tested on Earth's Plants

Moon dust doesn't hurt earth plants; in fact, it may even help them. Dr. Charles H. Walkinshaw of the Southern Forest Experiment Station reported this and other findings of the first comprehensive botanical tests to become available from the Apollo 11 mission.

Dr. Walkinshaw, plant pathologist, is the USDA Forest Service leader of the team of botanical scientists that are working at NASA to evaluate effects of lunar material on more than 30 species of plants from algae to pine trees. The

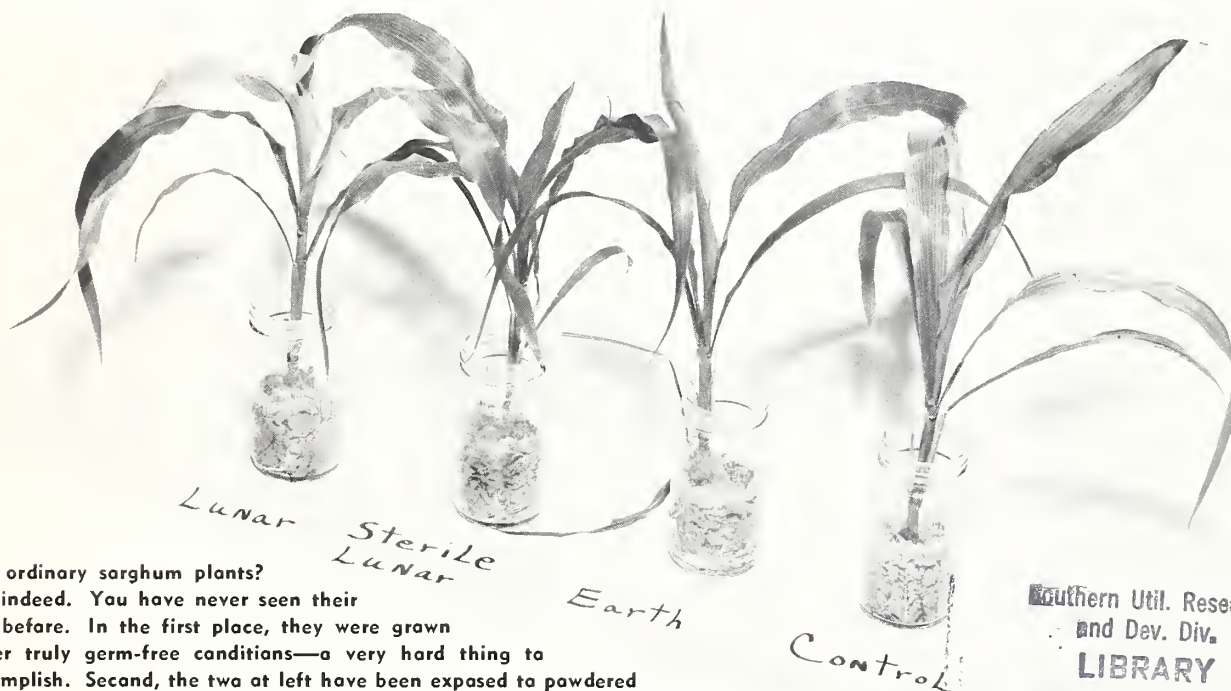
plants are grown under sterile conditions in the quarantine facilities of the Lunar Receiving Laboratory of NASA's manned spacecraft center in Houston, Texas.

Seedlings of higher plants such as tomato, bean, wheat, and pine were challenged with lunar material. All seedlings survived, and in some instances were healthier and grew better than those not receiving treatment. This was most noticeable in growth of the liverworts (a lower form of plant life). Microbes were not detected in the

pulverized moon rock used on the plants.

Dr. Walkinshaw explained that although this material is highly insoluble in water, plants excrete acids which release some minerals from it. These minerals can then be taken up by the plant and utilized for growth. Thus, lunar material acts similarly to earth soil. "If the lunar material were totally insoluble or inert it is unlikely that it would cause any effects in plant tests," he said.

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Just ordinary sarghums plants?

No, indeed. You have never seen their like before. In the first place, they were grown under truly germ-free conditions—a very hard thing to accomplish. Second, the two at left have been exposed to powdered moon rock since they were a few days old. The rock, in slurry form, was rubbed on their leaves and poured over the synthetic cellulose medium in which the roots are growing. After 30 days there were no signs of growth retardation, or of germs.

(NASA photo)

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A Research Goal: **More Productive Swamplands**

Southern swamps, which cover more than 4 million acres, can once again produce much-needed hardwoods. Though they were long ago stripped of their virgin cypress and tupelo, their soils are rich and right for trees that can stand plenty of moisture. But returning them to productivity will require new planting and management techniques. Southern Forest Experiment Station scientists are trying to



find ways to re-establish trees on bare swamp sites and to manage extensive stands of second-growth tupelo that have come up in some areas where virgin forests were logged.

The Atchafalaya Basin, one of the largest swamps in the South, serves as a giant outdoor laboratory for USDA Forest Service researchers. An area of some 1 million acres in south-central Louisiana, the basin is the flood plain of the Atchafalaya River and a diversionary channel for Mississippi River floodwaters. It originates near Simmesport, Louisiana, at the junction of Red River and Old River, and ends at the Gulf of Mexico near Morgan City. The basin is about 15 miles wide and 75 miles long—it extends all the way to the Gulf. The river follows a single channel through the northern end of the basin, but fans out into a series of channels, lakes, and other drainages through the southern part.

In much of the basin the cypress and tupelo were removed in the late 1800's and early 1900's by railroad skidder and pullboat logging. Railroad skidder logging was so destructive that little second-growth timber can be found where it was applied. Planting will be required to make these lands productive again.

Tupelo Tested

Many parts of the basin are flooded for long periods each



year. What to plant in such areas is a question Southern Station researchers are trying to answer. Harvey E. Kennedy, Jr., at the Southern Hardwoods Laboratory in Stoneville, Mississippi, studied tupelo seedlings planted under swamp conditions. Levees were built surrounding 66 test plots where soil and water conditions duplicated those of the Atchafalaya Basin. A pumping system controlled water levels, flooding the plots to several depths for varying periods. One-year-old water tupelo seedlings were planted in the plots.

Results were encouraging. Seedlings survived flooding above their tops when the water

receded early in the growing season. When the water was not above the tops of the plants, seedling survival was high even when flooded through the summer. Water tupelo grows as rapidly in swamps as some trees do on dry land, and its wood is in demand. The ability of planted seedlings to survive flooding, therefore, makes the species a prime candidate for swamp reforestation.

Green ash also shows promise. It grows well, and does not mind getting its feet wet during the growing season. Other species such as Nuttall oak, sycamore, and cottonwood can tolerate flooding during the dormant season and may be usable where water recedes early in the year.

Protection levees form the boundaries of the basin and largely determine flooding conditions there. Inside the protection levees are guide levees, lower in elevation, and extending along the river from its origin to south of Krotz Springs in St. Landry Parish about 10 miles on the east and 20 miles on the west side. These levees restrict headwaters of the river and prevent overflow.

Atchafalaya Unique

Soil conditions in the basin vary considerably and are unique in some ways from those found in other swamps. Waters of the Mississippi River have dumped millions of tons of silt into the area, building the land inside the protection levees as much as 10 feet higher than land outside the levees. Where the guide levees end, water-borne sediment spreads out like an ever-widening fan. The guide



levees, by preventing overflow, allow the soil to stabilize and support many of the bottom land hardwoods found throughout the South. In the northern part of the basin where soils have stabilized and there is good drainage, sycamore, pecan, hackberry, elm, and ash are thriving.

Second-growth stands of water tupelo are found in some sections. A typical stand averages 12 inches in diameter above the butt swell, is 65-70 feet tall, and up to 250 square feet of basal area per acre. Some of these stands need thinning.

Industry is experimenting with logging methods and equipment to get timber out of the swamp. It is an expensive and difficult undertaking, and unless growth of trees left standing is stimulated by thinning, clearcutting is advisable. Southern Station scientists are finding out whether it is best to thin or clearcut the trees.

If clearcutting is the choice, need for the information that is being gathered on regenerating swamplands becomes even more urgent if swamps are to be productive land.

A Search for Superior Parents

A story of how geneticists breed better trees by tracking down desirable parent trees and excluding offending members reads like a best-selling mystery novel.

Finding the right parents is the key to breeding superior trees, George K. Stephenson and E. Bayne Snyder point out in a recently published booklet of the Southern Station. Genetic variability is known to exist for volume production, straightness, limbiness, wood density, fiber length, and resistance to pests. Picking just the right seed parents to breed superior trees is a subject of intensive research in the USDA Forest Service. Sleuthing for wanted trees requires a lot of time and patience. It is more than a simple matter of measuring the differences between trees. The only way to learn what traits a tree can transmit to its offspring is to grow and evaluate young trees from seed. And trees don't grow overnight.

Most tree characters are complex, perhaps inherited through hundreds of individual genes. Most trees carry undesirable genes along with desirable ones. Sometimes these genes are recessive and show up only in the offspring. Genes may be transmitted independently or linked in groups. Segregating individual characters and untangling their maze of linkages so that they can be recombined requires complex breeding studies and intricate analyses. Such research,

exploring the bad as well as the good, the obscure traits as well as the obvious, is essential to tree improvement programs if

there are to be major gains in breeding better trees.

This exploration—providing knowledge to make tree improvement effective and efficient—is the purpose of the Southern Station's Institute of Forest Genetics at Gulfport, Mississippi. The Institute is aided by other Southern Station research units at Alexandria, Louisiana, Stoneville, Mississippi, and Crossett, Arkansas.

The new Stephenson-Snyder booklet, "Genetic Variation—Key to Superior Trees," explains the work. Numerous photographs illustrate the heritability of tree characters. Copies of the booklet are available from Southern Station headquarters in New Orleans.

O — O

The Nation's first area to be set aside as a breeding ground for the American osprey, a fish hawk which is losing its battle for survival, is being established by the USDA Forest Service in the Deschutes National Forest in Oregon.

O — O



Trees with fewer than average branches have better than average wood. Would reducing the number of branches slow growth? Can trees be bred to grow without limbs?

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With each species of plant, four sets were used for the tests. The first set was control plants, which received no treatment. The second set was treated with heat-sterilized earth materials, the third set with sterilized lunar rock, and the fourth set with unsterilized lunar rock. The earth "soil" was concocted from rock samples collected from a number of geographic regions and mixed to simulate, as closely as possible, scientists' preconceived ideas of moon dust. "We were wrong about some things, and for Apollo 12 a new batch of earth material is being made up," Dr. Walkinshaw said.

Some plant tissue cultures, for example tobacco, grew best and were greenest when sprinkled with unsterilized lunar rock powder. Uniformly, cultures treated with the sterilized

lunar rock did less well than those treated with the unsterilized rock. Dr. Walkinshaw therefore thinks that, "something is going on in the sterilization that changes the reaction of the plants to the material."

The Southern Station scientist said fern was especially interesting because its spores (equivalent to seeds in higher plants) grew best on lunar material. Lettuce also germinated and grew vigorously in the presence of moon rock. However, growth of algae was inhibited initially. Also, in longleaf pine tissue cultures most cells which came in direct contact with lunar material were quick to show initial inhibition, while untouched cells continued to grow vigorously. Thus the lunar dust appears to cause a number of responses, some beneficial and some detrimental.

Plans are going ahead for Apollo 12 tests. The botanical scientists are trying to arrange

experiments to determine to what extent lunar material could grow seedlings. "Plants cannot grow in moon dust alone, because it lacks sufficient nutrients. However, with the proper nutrients added it would serve as a good medium," Dr. Walkinshaw explained. He said the moon dust is unique both from a geological and biological standpoint. It has a high titanium content, is low in potassium and sodium, and appears to lack organic matter. "It is unlike anything else we know about. Moon is moon, that's all."

In addition to making these tests possible, the plant quarantine facilities developed at NASA's Lunar Receiving Laboratory have allowed truly germ-free plants to be produced. "This development opens significant new frontiers in plant disease investigations and basic research into the functioning of all plants," Dr. Walkinshaw said.



The plants in these jars are a species of liverwort (*Marchantia polymorpha* L.). They are being grown on agar, and all are given a standard nutrient solution. Those in the top row of jars also received 0.22 gram of lunar material 7 weeks ago, and now are bigger and greener than the others. The liverworts are primitive plants, related to the mosses. (NASA photo)

Planting Longleaf? Handle With Care

At last—longleaf pine can be planted as successfully as other species. And it is easier to direct-seed.

Originally the most abundant of the southern pine, longleaf now occupies only about one-fourth of the acreage it once dominated. A big cause for this decline has been longleaf's reputation as a difficult species to plant.

Development of direct seeding by the Southern Forest Experi-

ment Station's research center at Alexandria, Louisiana, provided a breakthrough in bringing back longleaf pine. William F. Mann, Jr., researcher at the Alexandria Forestry Center, says longleaf is the easiest of all southern pines to seed.

Now, after years of study and testing, Southern Station scientists have found that longleaf can be planted as reliably as other species provided seedlings are planted and handled with care. Sloppy practices damage longleaf more than loblolly, slash, or shortleaf pine.

Researchers find that one of the surest ways to improve survival is by growing stock in uncrowded nursery beds. Tests indicate that seedlings should be grown about 15 per square foot for optimum survival and cost.

Another practical, inexpensive way to boost survival is to root-prune seedlings at depths ranging from 4 to 7 inches. Pruning should be done 6 to 12 weeks before the seedlings are lifted from the nursery beds. Clipping needles back to 5 inches immediately before planting appears to improve survival on adverse sites, even though it may retard growth slightly. On more favorable sites, it is of doubtful benefit.

Views conflict on value of grading nursery stock, but Southern Station researchers recommend planting only stock of grades 1 and 2.

Mechanical site preparation boosts chances for survival. Scalping seems most practical for grassy sites, especially on

heavier soils, even though survival may be a little lower than with furrowing. On scalped sites sufficient fuels will develop by the time prescribed burns are needed for disease control. On furrowed sites fuel may be insufficient for burning. Disked strips should be allowed to settle for about 6 months before planting. Dense hardwood should be eradicated before seedlings are planted. Scattered hardwoods can be deadened in the first summer.

An article by Mann in the March 1969 issue of *Forest Farmer* describes techniques for planting and growing longleaf nursery seedlings. The article also points out where further research will be beneficial. Reprints are available from Southern Station headquarters in New Orleans.

O — O

The most rapidly changing sector of the southern timber economy is the veneer industry. Formerly the industry relied almost entirely on hardwoods, but in the past 5 years the manufacture of sheathing-grade pine plywood has risen to prominence. Nucleus of the industry is in Arkansas and Louisiana, largely because of the larger-than-average timber found there.

O — O

Hurricane Camille damaged 290 million cubic feet of timber in southern Mississippi. Timber of all sizes was affected.



Longleaf seedlings in a nursery bed, handled with care, can be planted as reliably as other species of pine.



Wanted For Ouachita Deer: More Browse

Population explosion is not a problem for deer in the Ouachita Forest in Oklahoma. Fact is, deer population there is limited. While scarcity of food may not be the only restrictive factor, sparseness of browse, especially evergreens for late winter forage, apparently is important in limiting deer numbers.

During the summer and fall of 1964, browse inventories were made on the Choctaw and Kiamichi Districts of the Ouachita National Forest in southeastern Oklahoma. About 181,000 acres were inventoried at the rate of one sample point per 1,000 acres. The timber type at each point was noted.

While average yields ranged from 85 to 182 pounds per acre, much of this was summer weight—with the leaves on the twigs. Average winter yield dropped off to 19 pounds per acre. Differences among types or between disturbed and undisturbed stands were not statistically significant, and there was little correlation between total browse yield and tree basal area. Position on the slope, direction of exposure, and soil fertility evidently accounted for more of the variation in browse than did stand density.

Availability of other food seems to determine how much

deer depend on browse. During winter deer turn to it chiefly when mast is scarce. Though there's evidence that browse isn't the best long-term diet, it seems likely that the scarcity of browse on the Ouachita is responsible in part for low deer populations.

Findings of the 1964 sampling have been published by the *Journal of Wildlife Management* in an article entitled "Deer Browse in the Ouachita Forest in Oklahoma" by Charles A. Segelquist, Southern Forest Experiment Station scientist, and Richard E. Pennington of the Ouachita National Forest. Reprints are available from the Southern Station.

Rusty Pines Related

Proof that races exist in *Cronartium quercuum*, the fungus which causes Eastern gall rust of pine trees, has been reported by two Southern Forest Experiment Station scientists from Gulfport, Mississippi. Their findings, reported in a paper read at the American Phytopathological Society meeting in Spokane, Washington, settle a long debate among forest pathologists. The gall rust is a widespread disease of pine trees in both the North and the South.

The USDA Forest Service researchers, A. G. Kais and G. A. Snow, inoculated five species of southern pine seedlings with six isolates of the fungus *C. quercuum* and four of *C. fusiforme*, which causes fusiform rust, the most serious disease of pine forests in the South. They used two *quercuum* isolates from Wisconsin, two from North Carolina, and two from Mississippi

to inoculate seedlings of slash, loblolly, shortleaf, jack, and sand pine. All *fusiforme* isolates were from Mississippi.

Only slash and jack pine were infected by the Wisconsin isolates, and only loblolly and sand pine were infected by the North Carolina isolates. All but sand pine were susceptible to the Mississippi isolates of *C. quercuum*. The trees responded similarly to all four isolates of *C. fusiforme*.

Differences between isolates were observed in the size and shape of galls which developed on infected stems and branches, lesion formation, and in recovery from symptoms. These tests established not only that races of *C. quercuum* exist, but also that *C. fusiforme* and *C. quercuum* can be distinguished as two species by responses of the hosts—another fact heretofore uncertain.

These findings will be useful to forest geneticists working to produce trees that are resistant to these two diseases.

Wonders Of Wood

Any teacher who has pondered plans for experiments for young teen science classes, or any parent who has helped a child search for a science project, will welcome a new publication called "Classroom Demonstration of Wood Properties."

The manual describes and illustrates 20 experiments that show some of the properties of wood and how these properties relate to the cellular structure of wood. The author is A. N. Foulger of the Forest Products Laboratory of the Forest Service, USDA.

Some of the demonstrations are simple, requiring little or no special apparatus, and can be used in the lower grades. Others are more complex and need equipment normally found in a botany laboratory. An imaginative teacher or student bent on winning a prize at the science fair could expand some of the experiments into elaborate demonstrations.

Where and how does water move in plants? What happens when wood gets wet? How strong is a single fiber? Why use glue? Why use plywood? The new manual answers these and other questions with detailed instructions for experiments. A glossary defines words as they apply in the wood demonstrations.

Copies of the booklet (USDA Program Aid 900) are available on request from the Southern Forest Experiment Station in New Orleans.

Pine Posts Preserved

A recent inspection of treated southern pine posts installed on the Harrison Experimental Forest in Mississippi revealed long life for posts treated with some preservatives.

In 1949 the U. S. Forest Products Laboratory in Madison, Wisconsin, in cooperation with the Southern Forest Experiment Station, installed posts treated with 44 preservatives for long-term evaluation. In 1964 more posts were installed, treated with 15 preservatives.

Annually, at inspection time, each post was given a "moderate push." If it broke off, it was considered a failure. The break

was then examined to see whether the failure was caused by decay, termites, or a combination of the two. If the post withstood the push, it was considered serviceable.

Of the 44 preservatives tested in the 1949 installation, 32 have survived 30 years of service and are still going strong. Most of the posts treated with coal-tar creosotes, creosote solutions, and pentachlorophenols remain in such good condition that their average service life cannot yet be predicted.

Untreated posts decayed rapidly, with the 1949 posts averaging only 2.3 years of life and the 1964 posts about 3 years. In contrast, none of the 1964 treated posts have yet failed.

Copies of the report, "Comparison of Wood Preservatives in Mississippi Post Study" by J. O. Blew and H. L. Davidson, are available from the Forest Products Laboratory in Madison, Wisconsin. Ask for USDA Forest Service Research Note FPL-01, 1969 Progress Report.

Stumpage Prices Analyzed

Stumpage prices of pine pulpwood in the South vary considerably by State and by sale in each State. Prices in the Southeastern States of Florida, Georgia, and South Carolina average \$2 higher per cord than in the Midsouth States of Arkansas, Louisiana, Texas, Alabama, and Mississippi.

Price variation is influenced largely by volume sold, size of sale area, number of buyers, and month of sale. In Southern Station Research Paper SO-44, Walter C. Anderson describes how

each factor influenced prices between 1960 and 1967.

For example, he finds that, for each additional bidder on National forest timber sales, price per cord increased by an average of 22¢. Prices in large sales were usually higher than those in small sales; they increased approximately 28¢ per cord with each addition of a thousand cords.

The paper, "Determinants of Southern Pine Pulpwood Prices," contains an equation for predicting stumpage price per cord when volume, size of sale, area, number of prospective buyers, and month of sale are known.

Buying Your Christmas Tree

Buying your Christmas tree can be an exciting and rewarding adventure. Or it can turn out to be a frustrating and discouraging experience if you go at it without some idea about Christmas trees.

To help you shop and care for your natural evergreen Christmas tree, the Northeastern Experiment Station of the USDA Forest Service has prepared a booklet called, "Buying Your Christmas Tree."

The booklet briefly discusses the history of the Christmas tree in addition to offering tips on selection, care at home, and safe disposal after the Yuletide season. There are sketches of the 15 most popular evergreen species.

Copies of the booklet may be had by writing the Northeastern Forest Experiment Station, 6816 Market Street, Upper Darby, Pennsylvania 19082.